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USSR CONFERENCES ON WELDING AND HEAT TREATMENT OF METALS

(Selected Translations)

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USSR CONFERENCES ON WELDING AND HEAT TREATMENT OF METALS

(Selected Translations)

/This report contains the translations of three articles concerning conferences on welding and the heat treatment of metals published in various USSR publications. Complete bibliographic information accompanies each article./

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ALL-UNION SCIENTIFIC-TECHNICAL CONFERENCE ON THE OVER-ALL MECHANIZATION AND AUTOMATION OF THE WELDING INDUSTRY

-USSR-

/Following is the translation of an article by V. M. Kondratovich in Svarochnoye Proizvodstvo (Welding Industry), No 2, Moscow, 1961, pages 41-43./

From 15 to 17 November 1960 the All-Union Scientific-Technical Conference on the Over-all Mechanization and Automation of the Welding Industry was held in Kiev under the auspices of the State Scientific-Technical Committee of the Council of Ministers USSR, the State Committee on Automation and Machine Building of the Council of Ministers of the USSR, the State Scientific-Engineering Committee of the Council of Ministers Ukranian SSR, the Electrowelding Institute imeni Ye. O. Paton of the Academy of Sciences of the Ukranian SSR, and the Central and Kiev Regional Administrative boards of the Scientific-Technical Society of the Machine-Building Industry.

Taking part in the conference were more than 400 representatives from the greater majority of economic regions in the USSR; 20 papers were heard.

The conference was opened by A. V. Topchiyev, vice-chairman of the State Committee on Automation and Machine Building of the Council of Ministers.

The director of the Electrowelding Institute imeni Ye O. Paton, Academician of the Academy of Sciences Ukranian SSR B. Ye. Paton, in a report entitled "Outlook for Future Growth of the Welding Industry," portrayed welding technology as one of the most powerful media for ensuring the creation of new industrial capabilities on the basis of modern engineering, as well as principally new and highly economical machine and equipment designs. It is because of these advantages in welding that the growth and development of welding technology in our country is attracting undivided and ever-increasing attention.

During the last two and a half years Soviet welding technology has made remarkable advances, putting it in first place in Europe with respect to the wide-scale application of modern mechanized welding techniques and the production of welded constructions. In the application of welding with fluxes and electroslag welding

our country was even ahead of the US.

In 1959, 7.5 million tons of welded constructions (greater by 30% than in 1958) were produced in the USSR, which meant a saving of about 650 million rubles. The volume output of fused products more than doubled, due considerably to the introduction of mechanized methods of wide layer fusion, fusion in a jet of shielding gases, vibroarc welding, etc. This led to a saving of about 220 million rubles.

Owing to the extensive application of automatic welding methods, the mechanization of welding operations attained a level of 24% toward the end of 1959, as opposed to 11% at the beginning of 1958. In the Ukranian SSR the level reached was 27.6%. In individual industrial areas (boilermaking, shipbuilding, etc.) the mechanization attained a level of 70-80%. In Soviet industry more than 12 thousand automatic and semi-automatic arc welding devices and more than 40 thousand contact welding machines are presently in operation. In 1959 alone the mechanization of welding operations made it possible to free thousands of workers in industry for availability in other operations and meant a nominal yearly economy in salaries of more than 140 million rubles.

Our advances would have been still greater had certain shortcomings not been present in the welding equipment. The rate of increase of the industrial potentials of welding equipment is not holding fast. The situation is very poor as regards the output of auxiliary equipment. The author called for the third year of the Seven Year Plan to bring forth an end to the lag in the engineering materials basis of the welding industry.

B. Ye. Paton then paused to consider some specific problems in the future development of the welding industry and the procedure developed at the Electrowelding Institute imeni Ye. O. Paton for determining the course of such development, based on the principle of proportionality between the increase in production of welded constructions and the expansion of the steel industry. Accordingly, since welding is a relative new form of metal working, its development in the future will proceed more rapidly than will that of riveting, coking, casting, punching, etc. The greatest rate of development of welding is foreseen in the next five years, with the level of Soviet welding technology, as far as production output of welded constructions is concerned, exceeding the level of the industrially most advanced capitalistic nations, especially the US.

The increase in production of welded constructions should at the same time be accompanied by a reduction in the specific expenditure of steel for their fabrication. Extensive application is being proposed for welded constructions of alloy steels, curved, bent, and tubular profiles and polymaterials, as well as rare metals, light and high-test alloys (titanium, zirconium, molybdenum).

Of utmost importance are punch-welded plastic components.

The author noted that currently the level and degree of

mechanization of the welding industry and the engineering-economic ratings of welded constructions rest primarily with the planning and design organizations. In this connection, the requirements for planners must be greatly stepped up. No small role is played by the large specialized branches of industry, the planning of which must be accorded particular attention.

The goal was set forth of raising the level of mechanization of welding in combined industrial applications to 75-90%.

Our scientists have before them the tremendous task of finding new methods of welding and fusion, practicable types of welded constructions, and methods for their fabrication and mounting that will realize the principles of full automation of the welding processes.

We need to invent processes of welding greater quantities of metal, methods for depositing very thin and ultra-thin layers, for studying the laws governing the formation of welded joints between various kinds of metals, and for finding the proper approach to the control and avoidance of large-scale failures in the fusion zone. A more deeply probing study of the strength of many-layered components under dynamic loading, fatigue conditions, and at high and low temperatures is of utmost necessity.

In metallurgy there is a need for expanding the production of fused and welded ingots of various kinds of rolled iron for self-sharpening plowshares, double-laminated rails, bimetallic strips, rolled profiles, etc. The technology of fusing components with nonferrous metals and alloys must be developed in every possible direction.

In the very near future a marked rise in the output of welding equipment and welding materials will be seen. At first the methods of arc welding will continue to assert their predominant role; later the production of equipment for contact welding, which permits the highest degree of over-all mechanization of welding, and equipment for brand new welding techniques will make their appearance. The years to come will witness a marked increase in the production of alloy wire, powder electrodes, argon, carbon dioxide for welding, and fluxes.

In concluding, B. Ye. Paton expressed his assurance that the rapidly growing scientific level of research in every branch of welding technology will enable us to count on an imminent solution to the up and coming problems facing us in the development of welding technology, thanks to the efforts of the scientific personnel of the research and planning institutes, in collaboration with the leading industrial enterprises.

The director of the All-Union Scientific Research Institute of Autogenous Welding, Candidate of Engineering Sciences A. N. Shashkov, presented a paper on the development of the technology of gas-flame treatment, the level of which has been steadily expanding in recent years. The production of components from the autogenous industry has increased by a factor of 17 during the period from 1940 to 1959. It must be noted that the increase in production of

oxygen and acetylene for the gas-flame working of metals is much greater than that in the US. The new types of components from autogenous machine-building factories has expanded during the same period by a factor of 6.5. The same high growth rates are predicted for the remainder of the Seven-Year Plan, for new production techniques and methods of mechanization and automation of labor they will be even higher.

The author considered in detail the prospects of further development of the gas-flame working of metals. He felt that we must sharply increase the output of mechanized facilities for oxygen-torch cutting, the level of application of which is all too deficient. We must extend the application of plants outfitted with central systems and cylinders for acetylene, which will save the country no less than 120 million rubles per year, as well as gas substitutes for acetylene. We need to push scientific research on gas-flame technology, primarily in the development of high output equipment and new engineering processes.

Candidate of Engineering Sciences P. I. Sevbo (Electrowelding Institute imeni Ye. O. Paton), in his paper entitled "Problems of the Over-All Mechanization and Automation of Welding," demonstrated that the newest phase in the development should be marked by a large-scale changeover from the mechanization of just the welding operations to the over-all mechanization and automation of the entire manufacturing process, including assembly, conveyance, accessories, as well as the preparatory, finishing, and other contiguous operations. The engineering-economic efficiency of mechanizing welding operations should be carried out throughout all of these stages. To do this, the reporter suggests a procedure for determining the true efficiency of both individual aggregates and the production line as a whole, introducing a resultant production efficiency $K = \frac{1}{1 - m + m/n}$, where n is the local efficiency factor of a given machine, m is a coefficient determining the specific weight of the given machine in the over-all production line.

As a first evaluation of the degree of mechanization of welding, a system of classification is proposed, indicating the mean coefficient of increase in efficiency for each class of equipment with the highest level of over-all automation.

Candidate of Engineering Sciences N. Ya. Kochanovskiy (All-Union Scientific-Research Institute of Arc Welding Equipment), in his report "Continuous-Operation and Automatic Assembly-Welding Lines Employing Contact Welding," showed that continuous-operation systems provided with the latest modern equipment introduce a manifold increase in efficiency and greatly reduce the level of labor. Contact welding is a process that ensures automation to the maximum degree of the mass production line; many electrode production line machines, with their high efficiency, prove to be extremely effective.

The author described the large number of machines of this type

developed and fabricated by the All-Union Scientific Research Institute of Arc Welding Equipment and the "Elektrik" plant for the welding of parts for locomotives, electric trains, railway cars, agricultural machinery, and other large-scale products. In the production process contact machines exist for the continuous-operation assembly-welding of bodies for the ZIL-130 truck. Welding machines are being made for the manufacture of the reinforcement for reinforced concrete, wherein the operations of alligning the rods, conveying them, feeding the cross rods, welding and cutting the mesh into the required length are automatic.

The author noted in conclusion that the number of extant mass production lines with contact machines is still far too small, but their planning and fabrication are slowly coming into realization.

Doctor of Engineering Sciences N. O. Okerblom (Leningrad Polytechnic Institute) presented a report on the topic "The Design of Rational Welded Constructions and Technological Processes for Their Manufacture by Mechanized Methods," wherein he showed that not only the manufacturing technology must be planned so as to utilize the most highly mechanized welding methods, but even the construction itself must comply in the end result with progressive engineering techniques. It is therefore imperative that we change over to updated construction-technological methods. The final products, he added, as well as the individual elements and components of the construction must have the necessary precision, eliminating difficult maneuvering in the assembly and subsequent alignment.

For this we must make use of analytic methods to determine the deformations, work out several modifications of the technological process of assembly and welding, selecting the one most suitable in the industrial sense.

The authors states that a procedure has been developed for calculating stresses, making it possible to determine where they need to be cut down and where, conversely, without lowering the functionality of the welded construction, they should be increased. The results of these investigations permit the assumption that the mechanical working of welded joints, and in many cases their heat treatment after welding may be eliminated.

A rational approach to design should allow for the possibility of cutting down the number of component parts, which would lead to a reduction in the amount of welding required.

Candidate of Engineering Sciences M. I. Baranov (All-Union Scientific Research Institute of Automotive Transportation), in a report entitled "The Mechanization and Automation of Welding Operations and Problems of Normalization and Unification of Welding Equipment," discussed the work being done at his institute to classify welded products, joints, and the principal welding techniques, making it possible to reduce considerably the types of machinery and fittings. This has resulted in a sharp curtailment of the planning and design period and the period for the

manufacture of specialized welding equipment (to six months). But these periods are not satisfactory for industry, which is faced with a growing need for the development of scientific bases for the mechanization and automation of welding operations, relying on normalization and the establishment of a far-sighted classification of welding equipment.

Doctor of Engineering Sciences I. I. Frumin and Candidate of Engineering Sciences I. K. Pokhodnya (Electrowelding Institute imeni Ye. O. Paton) outlined a method for the semiautomation of bare electrode arc welding, a method that was developed at their institute and which shows great promise for the mechanization of hand welding. In this welding technique they introduce a powder rod, type PP-AN-1, containing slag and gaseous substances and not requiring additional protection. The mechanical properties of the metal of the weld, using the powder rod, comply with the requirements for type E42 electrodes. Rods with diameters of 2.8-3 mm have been successfully produced in industry.

Candidate of Engineering Sciences D. P. Lebed' (Dnepropetrovskiy Metal-Design Plant imeni Babushkin) discussed the operation of a highly mechanized production line in the manufacture of welded H-beams in their factory. This experimental production line for the manufacture of welded beams is the first of its kind in the world. The main welds are made by means of an automatic three-arc welder at the rate of 100 m/hr. The output of the line is five beams per hour.

Engineer S. I. Rusakov (Gor'kiy Motor Vehicle Plant) discussed a test for the application of modern mechanized welding procedures in the automotive industry. The application of contact welding in the factory has multiplied by a factor of 13 in the last 15 years, flux welding by a factor of 17; the level of welding mechanization in the factory has reached 94.5%. The over-all production line mechanization and other measures has enabled the factory to achieve a sharp reduction in the difficulties involved in the assembly of the body for the new Volga passenger auto.

The operation of factories in setting up mechanized production lines was reported by Candidate of Engineering Sciences N. D. Portnoy (Ural Railroad Car Plant) on the manufacture of 100-ton rail cars by means of contact welding, Engineer D. P. Antonets (Zhdanovskiy Heavy Machine-Building Plant) on the manufacture of railroad tank cars with a capacity of 60 m^3, Engineer V. D. Kolesinkov (Luganskiy Steam Locomotive Plant) on the manufacture of parts for high-powered steam locomotives.

The following reports were also heard at the conference: by Engineer V. S. Volodin (State Committee on Automation and Mechanical Engineering of the Council of Ministers) USSR on "The Classification of Technological Processes and Techniques for the Mechanization of Welding," by Engineer L. A. Zhivotinskiy (All-Union Planning and Design Engineering Institute of Heavy Industry) on "Auxiliary Equipment for Welding and its Role in Over-All Mechanization and Automation,"

by Candidate of Engineering Schiences G. V. Rayevskiy, Candidate of Engineering Sciences B. F. Lebedev, and Engineer S. M. Beletskiy (Electrowelding Institute imeni Ye. O. Paton) on "The Industrial Method of Making Large-Scale Welded Products," Engineer M. V. Orlov (Leningrad) on "The Over-All Mechanization of Welding Operations in Shipbuilding, Providing for the Rational Construction of the Ship," and by others. Nineteen persons took part in the discussion of the papers.

Doctor of Engineering Sciences A. A. Alov (Moscow Aviation Engineering Institute) pointed out the shortcomings in the training of crews for many welding specializations and the need for broader operations in the solid fusion of constructions. He feels that arc welding will for a long time to come hold its dominant place over contact welding, and it should be accorded careful consideration in the plans for developing industry.

Engineer V. V. Chernykh (Novo-Kramatorskiy Heavy Machine Building Plant, Kramatorsk) discussed the organization of the metal construction industry in his factory. He proposed the creation of a special planning organization on the mechanization and automation of metal construction assembly plants. Engineer L. V. Yemel'yanov (All-Union Planning and Design Engineering Institute of Heavy Machine Building) came forward with a proposal for the creation of an institute on the over-all mechanization of the welding industry.

Candidate of Technical Sciences S. M. Lashchiver (Scientific Research Institute of the Automotive Transportation Industry) discussed the composite production line in the manufacture of air tanks in the automotive industry.

The eminent welding specialist, twice Hero of Socialist Labor A. A. Ulesov (Kuybyshevgidrostroy) noted the deficiencies in the technique of welding inspection. He feels that the present practice of determining quality by cutting control pieces from the construction is the most sensible one; at the Kuybyshevgidrostroy it resulted in the cutting of 2400 tons of armatures.

Engineer V. I. Krasnov (Chelyabinskiy Metal Design Plant) reported that the plant engineers decided to completely mechanize the welding of the crawling ditch digger. But this was complicated by the imperfection of the apparatus put out by the "Elektrik" Plant, in particular for welding in a carbon dioxide atmosphere. The author called for the production of a universal apparatus for flux welding, also in a carbon dioxide medium, as well as centralization of the production of powder rods and the improvement of their composition.

Engineer M. M. Fishkis (ZIL) remarked that there now exists a gap between the level of mechanization of welding and its concomitant operations. He discussed the experimentation being carried on at ZIL on the mechanization of the auxiliary operations (at his factory vertical storage of sheet metal has been introduced, a protective container is used, serving simultaneously as a stand for cutting the metal, parts are cleaned right in the oven during

anneal of the product, etc.).

Engineer B. D. Malyshev (State Institute for the Design, Study, and Testing of Fabricated Steel and Bridges) familiarized the conference with two production lines in the manufacture of welded H-beams and in the production of window casements. Beams for building constructions are made with a flange width of 100-700 mm and height of 60-500 mm from plates and strips 4-6 mm thick. Both welds are made simultaneously by two automatic welders. The incorporation of production lines has increased the output from 70 to 180 tons per worker.

A representative of the Vil'nyus Arc Welding Equipment Plant reported that the progress of this plant has been retarded as a result of the fact that until now they have been manufacturing vacuum cleaners, which constitute 26% of the gross output. The factory is also unable to increase its production of welding machinery in the required output because of the all too deficient building budget.

Engineer F. S. Reznichenko (State Scientific-Technical Committee of the Council of Ministers RSFSR) spoke on the very poor provisions for welding equipment from factories in the RSFSR. He noted the need for developing technically reliable norms on welding equipment by which the promulgation of the latter might be better planned.

Engineer Yu. I. Syamonov (Khabarovsk Sovnarkhoz) drew attention to the outlook for the development of welding in Khabarovskiy and Primorskiy Krays. He reported that mechanization has been held back in the eastern parts of the country by the lack of sufficient equipment. In Khabarovskiy Kray there are only 15 pieces of equipment in operation for welding in carbon dioxide gas; very little equipment is available from the Electrowelding Institute imeni Ye. O. Paton, for example, automatic fusion machinery. He noted in conclusion the need for stepping up the control of the construction bureaus, since many of them are still oriented toward outdated techniques.

Candidate of Engineering Sciences I. L. Brinberg (Central Scientific Research Institute of Technology and Machinery), speaking for the Scientific-Technical Society of the Machine-Building Industry, called upon the delegates to the conference to work for the reinforcement of intercommunication between the Scientific-Technical Societies and industry, to strengthen efforts toward the incorporation of new engineering practices. The original organization of the Scientific-Technical Society of the Machine-Building Industry, in affiliation with the Central Scientific Research Institute of Technology and Machinery, considers its fundamental task to be the introduction of the results of research into industry.

The conference adopted as its final resolution the further development of work on the over-all mechanization and automation of welding processes in industry and in building, in particular,

to step up the investigation of and search for new methods of welding and fusion, the development of modern programming and cybernetic systems for the regulation of welding processes, the insurance of rapid introduction into the exploitation of industrial capabilities for the output of welding equipment, mechanization procedures, and welding materials; to work out classifications of welding equipment and to work toward its normalization and unification; to request the Academy of Sciences of the USSR to commission an economic institute for developing in 1961 a procedure for determining the level, degree, and efficiency of over-all mechanization and automation of welding; to recommend to the Electrowelding Institute imeni Ye. O. Paton the organization of special commissions on the coordination of all work connected with the problems of mechanization and automation of the welding industry in the USSR.

The conference exhorted all workers, engineers, scientists, and innovators to direct their creative efforts toward the completion of the enormous tasks set before us at the Twenty-First Congress of the CPSU.

ALL-UNION SCIENTIFIC-TECHNICAL CONFERENCE ON THE APPLICATION OF INDUCTION HEATING IN THE HEAT TREATMENT OF METALS

-USSR-

/Following is the translation of an article by M. G. Lozinskiy in Metallovedeniye i Termichekaya Obrabotka Metallov (Metallography and the Heat Treatment of Metals), No 2, Moscow, 1961, pages 59-61./

From 26 to 29 October 1960 the All-Union Scientific-Technical Conference on the Application of Induction Heating in the Heat Treatment of Metals was held in Moscow under the auspices of The State Committee on Automation and Mechanical Engineering of the Council of Ministers of the USSR, the State Scientific-Technical Committee of the Council of Ministers USSR, and the Metallography and Thermal Processing Section of the Scientific-Technical Society of the Machine-Building Industry.

A total of 22 papers and ten reports were presented.

Taking part in the conference were 378 representatives of factories and scientific research and academic institutes from a number of cities in the Soviet Union.

In a paper by Doctor of Technical Sciences Professor I. N. Kidin (Moscow Steel Institute), "The Significance of Electrothermal Processing in Modern Metal Working," the author pointed up the lag in research on the properties and behavior of the transformations taking place in steel in connection with rapid induction heating, as well as the lag in practical application of the case hardening technique developed by Corresponding Member of the Academy of Sciences USSR V. P. Vologdin. The author pointed out some of the erroneous viewpoints on the most important phenomena that occur during the rapid induction heating of steel.

Some of the peculiarities evinced in steel upon induction heating were considered: a) comminution of the austenite grains; b) formation of finer mosaic cells; c) the possibility of obtaining a practicable degree of austenite heterogeneity. The need was pointed out for establishing the conditions of anneal following case hardening, taking into account the heat used to bring about the austenite heterogeneity.

The presence of a "supersolid" state in the case hardening of

medium carbon structural steels (to RC 6-8) and high carbon instrument steels (to RC 3-4) was experimentally demonstrated.

Recommendations were given for the most preferable conditions of rapid induction heating of steels for case hardening.

A paper by Candidate of Technical Sciences N. P. Glukhanov (Scientific Research Institute of High Frequency Currents imeni V. P. Vologdin), "Present State and Outlook for the Industrial Application of High Frequency Currents," was devoted to outlining the present state of induction heating technology in machine building. A method is specifically recommended for the case hardening of pinions with "two-frequency" heating, for the welding of various objects, etc.

Candidate of Technical Sciences Yu. M. Bogatyrev (Central Scientific Research Institute of Technology and Machinery), in a report entitled "The Large Volume Electrothermal Processing of Steel," reported on the application of induction heating for the refinement of steel. He pointed out that considerable advantages are involved in comparison with heating in furnaces, particularly in the processing of components of great length, and the behavior of heating and quenching by continuously alternating techniques. In continuous induction heating with currents at ordinary industrial frequencies (50 cps in the Soviet Union) specimens made from OKhM steel with diameters up to 150 mm had a finer-grained structure and higher mechanical properties than after furnace heating. For ingots with diameters of 90-100 mm "two-frequency- heating was employed: to temperatures of about 700° induction heating at 50 cps was applied, while for the heating of ingots to anneal temperatures high frequency currents (2500 cps) were used. The author remarked on the feature of electrothermal processing on a volume scale due to the reduction in duration of the process and the opportunity of realizing a broader temperature interval for quench heating, 950-1050° for OKhM steel, than in the case of continuous heating in a furnace. The expediency of short-duration high temperature heating for restoring the plastic properties of steel between individual operations of cold working under pressure was demonstrated.

Candidate of Technical Sciences K. Z. Shepelyakovskiy (Moscow Motor Vehicle Plant) delivered a paper entitled "The Case Hardening of Steel with Deep Heating," in which he reported on his work in the technology of case hardening following deep-penetration induction heating of steels with tempered hardness. These steels, with 0.5-0.7% C, belong to the class of carbon steels and can be melted in arc and Martin open-hearth furnaces. The chemical composition of the tempered steels is characterized by a limited content of the usual impurities, they must contain no more than 0.2% Mn, 0.3% Si, 0.15% Cr, 0.25% Ni, and the introduction of aluminum or aluminum and titanium is required.

It is very important that instead of the usual heating rates used for standard steels, 30-300 deg/sec, in the heating of the

highly developed tempered steels the rate of temperature rise in the phase conversion region can be no more than 2-10 deg/sec, the current supply source having a very much smaller power and operating at increased or very high frequencies. Another valuable feature of the new method is the increase in static, fatigue, and contact strength of the annealed specimens, an effect that is attained not only by hardening of the layer subjected to case hardening, but also of the deeper layer.

The new method of case hardening after deep induction heating of the tempered steel has been incorporated into the operations of industrial enterprises concerned with the manufacture of average module gears, etc. Here the prolonged and costly process of cementation is eliminated, and the necessity of using little available alloyed (including chrome-nickel) steels is circumvented.

Candidate of Technical Sciences M. N. Bodyako (Technical Physics Institute of the Academy of Sciences Belorussian SSR), in a paper entitled "On Recrystallization Processes in Induction Heating," reported on the characteristics of recrystallization in high frequency and furnace heating of commercial iron, nickel, copper, type 1Kh18N9T steel, titanium, and the alloy types VT-3 and VT-5. The author stated that with an increased heating rate recrystallization takes place at higher temperatures, because of the fact that with induction heating and the evolution of the initial stage of recrystallization the temperature rises steadily. The rapid completion (within one or a fraction of a second) of recrystallization was demonstrated.

Characteristic features of the anneal of metals and alloys with induction heating are a fine grain (4-8 times finer than after anneal with heating in a furnace) and enhancement of the plastic properties. This process can be carried out at higher rates, permitting its application in industrial drawing, rolling, and other operations.

In a report by Candidate of Technical Sciences M. M. Klimochkin (Central Scientific Research Institute of Technology and Machinery), "The Electrical Case Hardening of Cast Iron with Globular Graphite," results are cited from investigations conducted on high-test cast iron with perlite (90-100% perlite), perlite-ferrite (60-90% perlite), ferrite-perlite (20-40% perlite) and ferrite (5-20% perlite) structure.

Following case hardening, perlite cast iron gains considerable hardness, to RC 50-60. The maximum hardness is obtained at a temperature exceeding the furnace heating quench temperature by 75-125° for perlite irons and by 150-200° for perlite-ferrite irons. In the hardening ferrite irons the hardness increases with increasing anneal temperature and decreasing heating rate. The maximum hardness is attained at 1100-1150° instead of the 900-950° as in furnace heating. The disparity in values of the hardness is of greater significance than in volume heating; the increase in spread is magnified with increasing ferrite content in the initial structure of the cast iron

and with increasing induction heating rate.

Experimentally, a nearly threefold increase in resistance to crushing was found in perlite cast iron after case hardening, along with an increase in fatigue strength, studied in specimens with a diameter of 20 mm. It was also shown that the tendency to form quenched-in cracks in the case hardening of products made from high-test cast iron increases with increasing perlite content in the initial iron structure and with increasing anneal temperature.

In a paper by I. S. Demchuk and G. N. Ivanov, entitled "The Production Line Mechanization of Bending and Quenching of Shaped Rolled Iron with Heating by High Frequency Currents," detailed information is given on the new technology of bending and quenching shaped rolled iron with large cross sections, these operations being combined into a single one employing induction heating by high frequency currents generated by a 250-kw, 2500-cps motor generator. Industrial characteristics are given for a bending mill with a replaceable fixture for the bending of various profiles and capable of ensuring proper butt welding of each contiguous profile strip. The yearly saving from installation of one such apparatus was 800 thousand rubles.

A number of papers were devoted to the problems of improving the apparatus used to accomplish induction heating.

In a paper by Doctor of Technical Sciences M. G. Lozinskiy (Metallography Institute of the Academy of Sciences USSR), "Lines of Growth of Apparatus Design and Mill Equipment in the USSR and Abroad for the Heat Treatment of Steel and Cast Iron with the Application of Induction Heating," the author pointed up the need for producing equipment for induction heating by currents at industrial frequency with a power ranging from tens to several hundred kilowatts, using as the basic design the specimens developed at the Central Scientific Research Institute of Technology and Machinery. The author remarked on the shortcomings of Soviet vacuum-tube generators, which are far too large in physical size. For the generation of stepped-up frequency currents in the range 500-3000 cps with high efficiencies (to 95%) it is best to build thyratron generators with single-plate thyratrons. Particular attention was devoted to the regular production of machines and facilities for the application of induction heating, which would enable one to obtain a high engineering-economic net effect from the rapid practical application of induction heating in the various technological processes of machinery building. Examples were given of the practices employed in this industry abroad (US, England, East and West Germany, Czechoslovakia, etc.).

In a report entitled "High Frequency Equipment with Vacuum Tube Generators and Possible Approaches to Their Improvement," Doctor of Technical Sciences Prof. A. V. Donskoy reported on the parameters of Soviet-manufactured vacuum-tube generators. The author noted that modern vacuum-tube generators are fitted with high frequency kilovoltmeters, which make it possible to check

the operating conditions and ensure full reproducibility of the technological processes involved. In the newer models of vacuum tube generators a series of generator tubes with economic cathodes is utilized.

The nominal frequency of about 70 kc in the newer vacuum tube generators ensures the fullest utilization of high frequency equipment without having to shield the enclosures or use any kind of protective devices.

The extended nomenclature of vacuum tube generators, the diminution in physical size, and the furnishing of engineering accessories on the generators were discussed.

In a paper by A. A. Terzyan (Armenian Branch of VNIIEM /All-Union Scientific Research Institute of Electrical Machinery/, "A New Production Series of 12-125-kw Frequency Converters," detailed information was given on 12-, 20-, 30-, 50-, 75-, and 125-kw mechanical frequency converters that can be manufactured on a mass scale and which will enable one to obtain currents at frequencies of 8000, 2400, and 1200 cps.

New types of machinery for the case hardening of large-scale components were discussed by V. F. Artem'ev (Ural Machinery Building Plant) and I. M. Likhtshtein (All-Union Planning and Design Technical Institute of Heavy Industry) in their paper "Equipment for the Hardening of Large-Scale Machine Components After Induction Heating by Currents at Stepped-Up Frequencies." They reported engineering data on a vertical stand for the case hardening of cylindrical smooth rollers and worm gears (straight teeth, bevel teeth, helical gears) with diameters of 140-800 mm and length of the hardened part up to 3100 mm, over-all length of the roller to 6000 mm, and weights up to 10,000 kg.

For the hardening of gears with modules of 10-50 mm, diameters of 300-5000 mm and weights up to 15,000 kg a machine has been fabricated and is in use at the Urals Machine Building Plant; it consists of two hardening machines and a mechanized trolley bed for holding and moving the gears to be worked.

Examples of the application of the above machines and other types in use at the Ural Machine Building Plant were given in the paper.

The important problem of raising the efficiency of heating inductors in the performance of high frequency induction heating was the subject of a paper by I. P. Russinkovskiy (Experimental Scientific Research Institute of Metal-Cutting Lathes), "The Application of Ferrites for the Intensification of Induction Heating." The author reported on inductors that he built with ferrite magnetic circuits for the case hardening of large-scale components with the current supplied by low-power high frequency generators.

The need for the centralized fabrication of ferrite magnetic circuits and equipping magnetic circuits with standardized components, as well as powdered ferrite for the fabrication of magnetic circuits directly according to factory specifications was discussed. The author indicated the possibility of obtaining a high engineering-

economic efficiency from the extensive application of magnetic circuits in the inductors of high frequency equipment.

The paper "Automation of Heat Treatment Processes in Components with Heating by High Frequency Currents," by Candidate of Technical Sciences K. Z. Shepelyakovskiy and I. N. Shklyarov (Moscow Motor Vehicle Plant), was devoted to the improvement of induction heating technology in mass production. Information was reported on the methods of stabilizing the conditions of high frequency heating and cooling with simultaneous and continuously alternating methods of treating various articles, on the procedures of centralized power to supply several hardening machines from a single generator, and different types of accessories and components were demonstrated (bunkers, rotating tables, "mechanical hands," pneumatic, hydraulic, and pneumatic-hydraulic cranes, etc.). Circuits and apparatus were demonstrated for typical semiautomatic and automatic stands for high frequency heat treatment of various articles.

A new method of nitrocementation of steel with heating was reported by Doctor of Technical Sciences Prof. I. N. Kidin and Yu. G. Andreev (Moscow Steel Institute). It was shown that the application of induction heating makes it possible to reduce the optimum ammonia content in the gas mixture used for the nitrocementation process to 8-10% instead of the usual 30-33% in furnace heating, and to increase the content of nitrogen 1.5-2.5 times in the surface layer of components processed by induction heating.

The participants in the conference also heard reports on the application of induction heating in mechanical engineering.

Also noteworthy were the talks given by S. A. Yaitskov (Moscow Motor Vehicle Plant) on a technique for the intensification of continuous induction heating of forged ingots, E. I. Natanzon (Gor'kiy Motor Vehicle Plant) on the improvement of the technology of case hardening of mass production articles, G. F. Golovin Scientific Research Institute of High Frequency Currents imeni V. P. Vologdin on the cooling effect of liquids fed by a spray pump, etc.

A resolution was adopted to provide for the elimination of existing shortcomings in the practical application of induction heating in mechanical engineering and to stress the extreme importance of wider application of this method of heating in the solution of the problems which now stand before our industry as a part of the Seven Year Plan for development of the Soviet national economy.

GOR'KIY OBLAST CONFERENCE OF WELDERS

-USSR-

/Following is the translation of an article by Yu. A. Yuzvenko in Avtomaticheskaya Svarka (Automatic Welding), No 5, Kiev, 1961, pages 95-96./

In January 1961 the Oblast Conference on the Problems of Future Development and Inclusion into Industry of Welding Technology was held in Gor'kiy.

Taking part in the conference were representatives of manufacturing enterprises in Gor'kouskaya Oblast, the Electrowelding Institute imeni Ye. O. Paton of the Academy of Sciences Ukranian SSR, the Metallurgy Institute of the Academy of Sciences USSR, The All-Union Scientific Research Institute of Autogenous Welding, and other organizations, comprising a total of about 400 persons.

A paper was delivered by Academician of the Academy of Sciences Ukranian SSR B. Ye. Paton on the present state and future development of welding technology in the USSR. The author portrayed the achievements of welding technology and the outlook for its further development in the next 20 years on the basis of overall automation and mechanization of welding operations and the application of new engineering processes.

B. Ye. Paton noted the attainments of a number of enterprises in the Gor'kiy Economic Region (Gor'kiy Motor Vehicle Plant, "Krasnoye Sormovo," and others) in the utilization of the newest welding technology and the building of automatic welding production lines.

The state of welding technology in the factories of the Gor'kiy Economic Region and the measures taken for further development of welding was reported by Vice-Chairman of the Gor'kiy Sovnarkhoz T. I. Lapin. He discussed what successes had been achieved in the area of welding at the Gor'kiy Motor Vehicle and Pavlovsk Bus Plants and the firms "Dvigatel' Revolyutsii" and "Krasnoye Sormovo." At the Gor'kiy Motor Vehicle Plant a rational punched and welded design for the axle casings of new trucks is being incorporated, which will considerably curtail the outflow of metal and by the end of the Seven-Year Plan result in a savings of three million rubles.

Institute, the so-called electron guns.

The state and outlook for the development of welding in the "Krasnoye Sormovo" was described in a report by the assistant chief engineer of the plant, V. P. Ryavinkin. He reported on the considerable growth in new types of production with the use of welded constructions (ships with hydrofoils, tankers, marine and railroad ferries), and on the transition of seamless forged and poured bars to punched and welded and poured and welded constructions (coamings, sternposts, rudder heads, and other components). The level of mechanization of welding at the factory climbed during the period 1957-1960 from 56.5 to 61%. The factory utilizes electroslag welding of steel constructions and argon arc welding of aluminum alloys. They are currently building a welded three-hundred berth diesel ship, the "Sputnik," with hydrofoils. Labor efficiency has been increased 1.5-1.7 times in the welding of plane saw blades. This has been possible because of the inclusion of single-rod welding with coercive forming of the back side of the weld by TS-32 welding tractors.

The inclusion of mechanized fusion of rollers has reduced the unfulfilled demand for them by 50%.

The type MDFKS gas-fed automatic cutters with remote control are in successful operation at the factory, their utilization having saved 40 thousand rubles and made available more than 100 m^2 of working area.

Candidate of Technical Sciences Yu. A. Yuzvenko, in a paper on the work of the Electrowelding Institute imeni Ye. O. Paton, discussed the high-efficiency fusion of electrode stripping, hydroturbine vanes, rollers for roller bearings, rollers for the tracks of caterpillar tractors, and other components. The author remarked on the efficiency of obtaining wear-free bimetal by rolling bars fused or welded by the electroslag technique, and he reported on a new piece of high-output fusion equipment.

Engineer N. K. Makarov reported on the application of arc welding and fusion in the Gor'kiy railroad system. The author noted that the welding of the rails has made it possible to extend their lengthto 25 m or more. On one kilometer of track containing such rails 3.4 tons of steel are saved. The rails are welded on the type RRSKM contact machine. The fusion of cross pieces and spiked rail ends are employed extensively on the Gor'kiy railroad.

Candidate of Technical Sciences V. A. Petrunichev (Metallurgy Institute of the Academy of Sciences USSR), in a report entitled "The Cutting and Welding of Metals by a Plasma Arc," described the high efficiency of using a plasma arc for the welding and curring of metals and alloys.

Candidate of Technical Sciences N. F. Kazakov presented a paper entitled "The Vacuum Diffusion Welding of Metals and Alloys," in which he reported on the high strength of welded joints obtained by diffusion welding in vacuum in the production of bimetallic articles from unlike metals and alloys. The author discussed the

Poured constructions are in the process of being changed over to constructions welded from rolled and cast metals at the "Dvigatel' Revolyutsii" Plant. The basic frame for a 3300-kg diesel engine is made by welding rolled and cast metal, as a result of which the weight of the frame as a whole is cut down by 1400 kg.

The production of welded constructions according to the Sovnarkhoz has increased by 38% during the two years of the Seven Year Plan; the level of mechanization of welding operations according to rough calculations was 78% in 1960.

A paper on new work in the mechanization of welding and electroslag smelting was presented by Candidate of Engineering Sciences B. I. Medovar (Electrowelding Institute imeni Ye. O. Paton).

Data were reported in the paper on the newer types of welding rods and fluxes, designed for the welding of high-fusing steels and alloys, on the testing of electroslag welding of gross annular components with large cross sections, and on the new technology of welding two layered sheets. B. I. Medovar discussed a new technique for producing multilayered rolled metal from welded and fused stock.

The application of the electroslag process in metallurgy, electroslag smelting of expendable electrodes in a water-cooled metal crystallizer, greatly enhances the quality comparability of alloyed steels and alloys.

Assistant Chief Engineer of the Gor'kiy Motor Vehicle Plant S. I. Rusakov, in a paper entitled "The Application and Future Possibilities of Welding at the Gor'kiy Motor Vehicle Plant," reported that with an annual output of 236 tons of welded products welding has been mechanized to the extent of 94.5%. An assembly and welding line for the floor of the Volga automobile chassis, equipped with three automatic multiple projection contact machines, which weld up to 200-240 spots each. The use of welding in a carbon dioxide atmosphere with the type A-547-R semiautomatic machines has improved the quality of the chassis, reduced buckling, and increased output two to three times. The inclusion of new welding techniques has reduced the labor involved in the manufacture of the unwieldy Volga chassis to 41 man-hours.

On the basis of techniques developed at the Electrowelding Institute work has begun on the appropriation punched and welded rear axle casings for the newer trucks. In the manufacture of wheels for passenger cars disks are accurately welded to the rim, thus permitting the use of tubeless tires. As a result of overall automation and mechanization of the welding processes, production has been stepped up 1.5 times.

O. K. Nazarenko presented a paper entitled "Cathode Ray Welding and the Prospects for its Development." He discussed the work being done at the Electrowelding Institute imeni Ye. O. Paton in this area. This new method of welding is widely used in joining high-melting and chemically active metals: tungsten, molybdenum, chromium, and others. The author reported on the industrial equipment for cathode ray welding developed at the Electrowelding

type SDVU-1 and SDVU-2 equipments for the welding of high-speed, high-fusing, and mineral ceramic plates with the cutting instrument holders.

Papers were also read at the conference by the following:

V. A. Kuznetsov (Metallurgy Institute of the Academy of Sciences USSR) on "Ultrasonic Welding";

Engineer V. A. Kolchanov on "Progressive Welding Techniques Employed at the Teplokhod Factory";

Engineer V. N. Gurashov (PTNII) on "Physical Methods for the Inspection of Welded Joints";

Engineer V. V. Yevseyev on "Progress in Welding in the Manufacture of Crushing and Grinding Equipment";

Engineer I. Ye. Yermakov on "Welding in Boat Building";

Engineer I. F. Terekhov (Kulebaki Metallurgical Plant) on "The Fusion of Rollers";

Engineer A. N. Tigashin ("Dvigatel' Revolyutsii" Plant) on "The Incorporation of Automatic Welding";

Engineer A. A. Fedotov ("Dvigatel' Revolyutsii" Plant) on "The Fusion of Cutting Tools";

Engineer A. I. Maykopar (Promtekhmontazh Combine No. 8) on "The Application and Future Development of Welding in the Combine No. 8.

Films shown on welding elicited the general interest of the delegates.

A complete welding exhibit was set up at the conference. Consultations and talks on the problems of welding technology were held.

The final resolution adopted by the conference was to take further measures for the continued inclusion into industry of advanced welding procedures.

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